LEGIONELLA CONCERNS

Legionella are bacteria (roughly 0.6 microns in diameter)[5] that are commonly present in aquatic environments and can easily live under aerobic or anaerobic conditions. They naturally infect free-living amoebae and incidentally infect the phagocytic cells within human lungs. Intracellular growth of legionellae within protozoa and within diverse microbial biofilms may be the primary means of proliferation.[3] They are present in natural and municipal water systems in very low concentrations. Legionella thrive in water at temperatures of 77 to 108 degrees F. To be dangerous, they must be concentrated by a process called amplification. Stagnant conditions and the presence of scale, sediment, biofilms, and amoebae favor amplification. The amplified environment must then be transmitted for Legionnaires' disease to occur. Transmission to humans occurs when water containing the organism is aerosolized in respirable droplets (1 to 5 microns in diameter) and inhaled by a susceptible host. Water droplets less then 5 microns in diameter can remain airborne indefinitely[1] and can be deeply inhaled into the lungs, therefore are of the most concern.[3] Such aerosols can be created by shower heads, aerators, spray nozzles, water impacting hard surfaces, and bubbles breaking up.

After amplification and transmission, a susceptible human host is required to contract Legionellosis. People whose immune system is suppressed by age, disease, drugs, or immunodeficiency are at high risk making hospitals, nursing homes, and other health care facilities of particular importance.[3]

Controlling the population of microorganisms may be the best way to minimize Legionella.[3] Operation, maintenance, and good housekeeping procedures are the main methods for preventing Legionnaires' Disease (Legionellosis; Legionella pneumophila). O&M considerations are beyond the scope of this document. The following are some design considerations that can aid in the reduction of the amplification and transmission of the offending bacteria.

Potable hot water

Legionella are killed in a matter of minutes when exposed to temperatures above 140 degrees F.[2] A preset thermostatic mixing valve should be considered if the delivery temperature is above 140 degrees F. to prevent scalding.[3]

The warm water section of pipe between the control valve and the showerhead should be self-draining.[3]

Cooling Towers and Evaporative Condensers

This equipment operates at temperatures that are ideal for the growth and amplification of Legionella. Since scale, sediment, and debris contribute to amplification, mechanical filters or centrifugal separators in the condenser water line can be useful.[3]

Equipment location is important and the following should be considered:[3]

- Locate as far as possible from fresh air intakes and operable windows
- Locate away from sources of organic matter such as kitchen exhaust
- Locate down wind (prevailing wind) of outdoor public areas
- Locate away from future construction sites

Towers with an open distribution pan should have a cover to block the sun.[4] Eliminating sunlight from wetted surfaces such as distribution troughs, cooling media, and sumps significantly reduces algae growth.[1]

Tower design should minimize drift since that is the primary way that legionella are transmitted from them.[4]

The condenser water system should make provisions for the User's preferred method of water treatment.

Air Handling Units

As previously stated, the best defense against Legionellosis is to prevent amplification. If there is a need to neutralize aerosolized contaminated water from an air stream, the following is pertinent. There are four main methods to keep the concentration of bacteria in a building environment low enough to prevent infections:[5]

- Purging with outside air
- Filtration
- Ultaviolet germicical irradiation, UVGI
- Isolation through pressurization

It should be noted that health care facility Codes might be more stringent then that required for the mitigation of legionella because the Codes must consider viruses, which are smaller.

Purging with Outside Air – 100% outside air has the same effect on airborne bacteria as recirculated air through a HEPA filter.[5] If the choice is economic, the difference in operating cost, energy, and maintenance depends on the climate.

Air filtration - 99.9% of all bacteria (and therefore legionella) are removed by 90 to 99% efficient filters, (ASHRAE Standard 52.1). This is because bacteria are typically present in colony-forming units that are larger then 1 micron.[1] HEPA or ultra low penetration air (ULPA) filters provide the greatest efficiency currently available.

UVGI – Single pass air handling unit, AHU, systems with UVGI are marginally effective. Recirculation through an AHU with UVGI can have a major impact on airborne bacteria (therefore legionella).[5]

Isolation with Pressurization is actually a sub-set of Purging with Outside Air.

ASHRAE Guideline 12 – 2000 has detailed information on amplifying environments, transmission sources, and O&M strategies.

REFERENCES
LEGIONELLA CONCERNS

1 Health Care Facilities, Chapter 7.2, ASHRAE Applications Handbook, 1999

2 Water Treatment, Chapter 47.6, ASHRAE Applications Handbook, 1999

3 New Guidelines on Legionella, David Geary, ASHRAE Journal, 9/2000

4 Cooling Towers, Chapter 36.12, ASHRAE Systems and Equipment Handbook, 2000

5 Airborn Respiratory Diseases and Mechanical Systems for Control of Microbes, W.J.Kowalski, HPAC, 7/1998